Clinical Practice Guideline

Heart Failure Council of Thailand (HFCT) 2019 Heart Failure Guideline: Introduction and Diagnosis

Ariyachaipanich A, MD[1], Krittayaphong R, MD[2], Kunjara Na Ayudhya R, MD[3], Yingchoncharoen T, MD[4], Buakhamsri A, MD[5], Suvachittanont N, MD[6]

[1] Division of Cardiovascular Medicine, Department of Medicine, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand

[2] Division of Cardiology, Department of Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

[3] Heart Center, Vichaiyut Hospital, Bangkok, Thailand

[4] Cardiology Unit, Department of Internal Medicine, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

[5] Cardiology Department, Faculty of Medicine, Thammasat University, Pathum Thani, Thailand

[6] Heart Center, Rama 9 Hospital, Bangkok, Thailand

J Med Assoc Thai 2019;102(2):231-9
Website: http://www.jmatonline.com

Guideline Development

This guideline contains sets of recommendations and summaries of evidence that were compiled to help physicians improve the standard of care in patients with heart failure (HF). The recommendations in this guideline are based on the best and most recent available data; however, any data presented herein may be superseded by new data at any point in time after the publication of this guideline. These algorithms and protocols were developed based on the assumption that clinicians will gather input from a multidisciplinary team (e.g., HF specialist, cardiologist, internist, nurse, pharmacist, physical therapist, social worker, etc.), and that the findings, treatment alternatives, local availability, and possible outcomes will be discussed with the patient before individualized clinical decisions are made.

Class of recommendation

The class of recommendation (COR) is a statement of the strength of the recommendation, and the likelihood that the intervention (diagnostic test or therapeutic strategy, medication, device, procedure, or other intervention) will yield benefit or harm (Table 1).

Correspondence to:

Ariyachaipanich A.

Division of Cardiovascular Medicine, Department of Medicine, Faculty of Medicine, Chulalongkorn University, Bangkok 10330, Thailand.

Phone: +66-2-2564291 ext. 0, **Fax**: +66-2-2564291 ext. 214

Email: aekarach.a@chula.ac.th

Level of evidence

The level of evidence (LOE) describes the certainty or precision of the evidence supporting the recommendations based on the type and quality of the evidence (Table 2).

Central illustration

The Central Illustration (Figure 1) of this guideline will provide a quick summary of HF management to the members of the healthcare teams.

The first step is making a diagnosis, which is outlined in Section A - Diagnosis. HF is a clinical syndrome with typical symptoms and signs that result from abnormal structure or function of the heart. A diagnosis of HF requires the satisfaction of both of the following criteria, 1) symptoms and signs of HF, and 2) evidence of cardiac abnormalities. This diagnostic protocol was designed to improve the sensitivity of the diagnosis without including patients with other causes of dyspnea.

After diagnosis of HF, it is essential that the steps in the Section B - Must Do (5C system) section of the central illustration be considered and/or performed prior to proceeding to any other steps or treatments. Since HF is not a final diagnosis, the primary cardiac abnormality should be investigated, identified, and

How to cite this article: Ariyachaipanich A, Krittayaphong R, Kunjara Na Ayudhya R, Yingchoncharoen T, Buakhamsri A, Suvachittanont N. Heart Failure Council of Thailand (HFCT) 2019 Heart Failure Guideline: Guideline Development. J Med Assoc Thai 2019;102:231-9.

Table 1. Class of recommendation

I	Evidence and/or general agreement that a given treatment/procedure is beneficial, useful, and effective. RECOMMENDED OR INDICATED
IIa	Conflicting evidence and/or a divergence of opinion regarding the usefulness/efficacy of a given treatment or procedure. Weight of evidence/opinion is in favor of usefulness/efficacy. SHOULD BE CONSIDERED
IIb	Conflicting evidence and/or a divergence of opinion regarding the usefulness/efficacy of a given treatment or procedure. Weight of evidence/opinion is less well established by evidence/opinion. MAY BE CONSIDERED
III	Evidence and/or general agreement that a given treatment or procedure is not useful/effective, and in some cases may be harmful. NOT RECOMMENDED

Table 2. Level of evidence

Level of evidence A	Data derived from multiple randomized clinical trials or meta-analyses
Level of evidence B	Data derived from a single randomized clinical trial or large non-randomized studies
Level of evidence C	Consensus expert opinion and/or small studies, retrospective studies, and/or registries

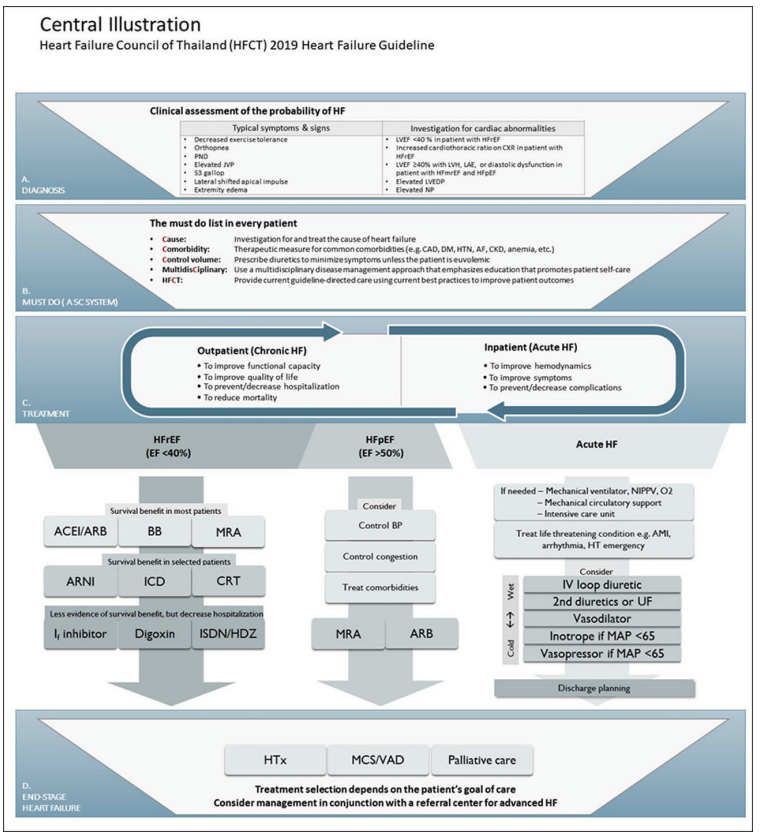

Figure 1. Central illustration for the HFCT 2019 Clinical Practice Guideline.

ACEI=angiotensin converting enzyme inhibitors; AF=atrial fibrillation; AMI=acute myocardial infarction; ARB=angiotensin II receptor blockers; ARNI=angiotensin receptor-Neprilysin inhibitor; BB=beta blockers; BP=blood pressure; CAD=coronary artery disease; CKD=chronic kidney disease; CRT=cardiac resynchronization therapy; CXR=chest X-ray; DM=diabetes mellitus; EF=ejection fraction; HDZ=hydralazine; HF=heart failure; HFCT=Heart Failure Council of Thailand; HFpEF=heart failure with preserved ejection fraction; HFrEF=heart failure with reduced ejection fraction; HT=hypertension; HTN=hypertension; HTx=heart transplantation; ICD=implantable cardioverter defibrillator; ISDN=isosorbide dinitrate; IV=intravenous; JVP=jugular venous pressure; LAE=left atrial enlargement; LVEDP=left ventricular end-diastolic pressure; LVEF=left ventricular ejection fraction; LVH=left ventricular hypertrophy; MAP=mean arterial pressure; MCS=mechanical circulatory support; MRA=mineralocorticoid receptor antagonist; NIPPV=non-invasive positive pressure ventilation; O2=oxygen; PND=paroxysmal nocturnal dyspnea; UF=ultrafiltration)

treated. It is known that HF patients commonly have many comorbidities that may worsen patient symptoms and prognosis. Many of these comorbidities may need specific treatments. Then, since congestion is part of the syndrome of HF, diuretic is needed in most patients to control symptoms. Finally, whenever possible, a multidisciplinary, guideline-directed approach to patient management is recommended.

Regarding treatment, the guideline recommendation is divided according to whether the patient is being taken care of in an outpatient setting (including at the time of discharge) or in an inpatient setting, which includes an urgent visit at the outpatient clinic or emergency department. Each of the two setting has different goals of treatment and a different set of recommendations that cannot applied to the other.

In the chronic HF or outpatient setting, patients are further classified by their percentage of left ventricular ejection fraction (LVEF). In patients with LVEF of less than 40% (HF with reduced EF, HFrEF), there are multiple classes of medications that should be considered first for their survival benefit. These disease-modifying medications should be initiated when appropriate, and then uptitrated to the maximum recommended dose or the highest dose that the patient can tolerate. Cardiac implantable electronic device (CIED), such as implantable cardioverter defibrillator (ICD) and cardiac resynchronization therapy (CRT), are also recommended to improve survival. Other agents are equally important for controlling symptoms since patients with HFrEF also have high disease burden. In patients with LVEF greater than 50%, so-called HF with preserved EF (HFpEF), the benefits of treatment are less evident. Controlling blood pressure (BP), and volume status should be the focus with a few classes of medications that have been shown to have limited benefits.

In an acute or inpatient setting, urgent/emergency management is needed if the patient develops respiratory failure or shock. Physicians should remain vigilant for critical, life-threatening conditions that may present in patients with acute HF. Patients should then be classified according to their hemodynamic status, such as Warm-Wet, Warm-Dry, Cold-Wet, or Cold-Dry, which will guide further treatment, including diuretic, vasodilator, inotrope, and vasopressor.

Even after receiving optimal HF treatment and comorbidity management, some patients still progress to advanced HF or end-stage HF. These patients should be considered for advanced therapy, such as heart transplant, mechanical circulatory support, or palliative care.

Introduction

Improvements in acute cardiovascular care and increased life expectancy of the population have vastly increased the number of patients that live with HF. In Western countries, 1% to 2% of the population lives with HF. The prevalence of HF in Thailand is unknown, but the prevalence in Southeast Asia was reported to be 5% to 7%[1].

In 2016, fifteen percent of Thailand's 65.3 million people were aged older than 60 years[2]. Death certificate data showed the leading causes of death in the overall population to be cancer, cerebrovascular disease, pneumonia, ischemic heart disease, and land transport accidents. The prevalence rate of and mortality rate in cardiovascular disease in Thailand has been increasing over the last decade and reached 48.7 and 32.3 deaths per 100,000 population for cerebrovascular disease and ischemic heart disease, respectively in 2016. The mortality rate of HF in Thailand was unknown but in an acute setting (hospitalized patient with admission diagnosis of acute HF), the THAI-ADHERE study, showed in-hospital mortality rate was 5.5% and the median length of hospitalization was 7.5 days.

HF is a common final pathway of various cardiac abnormalities, and caring for patients with HF can be a challenge. The mortality rate in HF is still very high at 10% per year. Patients with HF are commonly hospitalized, and approximately 50% of HF patients expire within five years after diagnosis. In the United States, HF is the most common admission diagnosis in patients aged older than 65 years[3]. In addition to the effect of HF on the patient, this clinical syndrome also significantly adversely affects patient family members and caregivers.

Over the last three decades, dramatic advances have been made relative to both our understanding of HF, and our strategies for diagnosing and treating HF. Multiple medication classes have been developed and introduced that have shown mortality and morbidity benefits. Cardiac implantable electronic device (CIEDs), such as implantable cardioverter defibrillator (ICDs) and cardiac resynchronization therapy (CRT), are now the standard of care in selected HF population. Toward the end of the clinical spectrum, some patients with severe HF can benefit from heart transplantation, mechanical circulatory support devices, and palliative care. The broadening and complex nature of HF patient care has placed greater emphasis on a multidisciplinary team approach with a system-based, patient-centric, longitudinal, disease management program.

Table 3. Clinical assessment of the probability of HF

Typical symptoms & signs	Investigation for cardiac abnormalities
• Decreased exercise tolerance	• LVEF <40% in patient with HFrEF
• Orthopnea	• Increased cardiothoracic ratio on CXR in patient with HFrEF
• PND	• LVEF ≥40% with LVH, LAE, or diastolic dysfunction in patient with HFmrEF and HFpEF
• Elevated JVP	• Elevated LVEDP
• S3 gallop	• Elevated NP
• Lateral shifted apical impulse	
• Extremity edema	

CXR=chest X-ray; HFmrEF=heart failure with midrange ejection fraction; HFpEF=heart failure with preserved ejection fraction; HFrEF=heart failure with reduced ejection fraction; JVP=jugular venous pressure; LAE=left atrial enlargement, LVEDP=left ventricular end-diastolic pressure; LVEF=left ventricular ejection fraction; LVH=left ventricular hypertrophy; NP=natriuretic peptide; PND=paroxysmal nocturnal dyspnea

Definition and pathophysiology

HF is a clinical syndrome that is caused by abnormalities in the cardiovascular system that lead to typical symptoms and signs that include breathlessness, exercise intolerance, extremity swelling, jugular venous engorgement, and pulmonary edema.

This syndrome is usually progressive with a relatively stable outpatient phase that is referred to as chronic HF, which is often followed at some point in the future by an urgent phase that requires active evaluation and treatment, and this phase is referred to as acute HF.

It is important to emphasize that HF is a systemic disease that affects the entire body. The pathogenesis is initiated by various abnormalities of the cardiovascular system. These abnormalities can include aberrations in the structure or function of the cardiovascular system, including the myocardium, valves, great vessels, pericardium, and systemic or pulmonary vascular system; however, the presence and severity of HF symptoms may not correlate with underlying cardiovascular abnormalities.

The compromise in blood circulation shown by elevated filling pressure, decreased cardiac output, and/or insufficient organ perfusion, then leads to the activation of the autonomic nervous system, the hormonal system, and cytokines, which are all hallmarks of the pathophysiology of HF syndrome. These alterations result in maladaptive remodeling in the left ventricle, which are usually classified as systolic dysfunction or diastolic dysfunction.

In physiologic terms, HF is a syndrome in which there is insufficient augmentation of cardiac output in response to increased systemic demand during activities or stress.

Diagnosis

The clinical syndrome of heart failure is a clinical diagnosis. There is currently no commonly used diagnostic criteria for HF. Investigations, such as blood tests and imaging modalities, are used to confirm diagnosis, to rule out other causes, to determine the classification of HF, and to investigate possible etiologies, the results of which are used to guide therapy.

In both inpatient and outpatient settings, a diagnosis of heart failure is likely if the patient has typical symptoms and signs (Table 3). The importance of having typical symptoms and signs of HF cannot be overemphasized. These symptoms and signs can be summarized into two groups, as follows, 1) findings of increased congestion, such as orthopnea, paroxysmal nocturnal dyspnea (PND), weight gain, extremity swelling, ascites, and crepitation, and 2) findings of decreased systemic perfusion, such as dyspnea, fatigue, exercise intolerance, lightheadedness, tachycardia, narrow pulse pressure, S3 gallop, and cold and pale extremities. Another challenge is that symptoms and signs of HF are non-specific and may be caused by other conditions. As such, not all patients who have the mentioned symptoms and signs will meet the diagnostic criteria for HF.

Investigations are focused on detection of cardiac abnormalities Echocardiogram and cardiac magnetic resonance imaging are commonly used. Abnormality in LVEF is a common finding. Other abnormalities of chamber geometry and function, including size, thickness, and mass, are evidence of cardiac abnormalities. From a physiological perspective, evidence of elevated filling pressure by cardiac catheterization (e.g., such as elevated left ventricular end-diastolic pressure (LVEDP), or pulmonary wedge

Table 4. Common and less common findings in patients with HF

System	Common	Less common
Cardiovascular system	• Decreased exercise capacity/tolerance • Orthopnea, PND • Extremity edema	• Chest pain • Nocturnal cough • Wheezing • Palpitation • Dizziness • Syncope • Bendopnea • Murmurs • Irregular pulse • Trepopnea
Non-cardiovascular system	• Early satiety, bloating • Right upper quadrant discomfort • Nausea • Anxiety • Depression • Confusion	• Weight loss • Cachexia • Pleural effusion • Cheyne-Stokes respiration • Hepatomegaly • Jaundice

PND=paroxysmal nocturnal dyspnea

Table 5. Cut-off values and interpretation of natriuretic peptide in patients with suspected HF in non-acute and acute setting

Setting	Natriuretic peptide value	Interpretation
Non-acute setting	BNP <35 pg/mL or NT-proBNP <125 pg/mL	HF is unlikely
Acute setting	BNP <100 pg/mL or NT pro-BNP <300 pg/mL	HF is unlikely
	BNP >500 pg/mL or NT pro-BNP >450 pg/mL (in patients <50 years) NT pro-BNP >900 pg/mL (in patients 50 to 75 years) NT pro-BNP >1,800 pg/mL (in patients >75) years)	HF is likely

BNP=B-type natriuretic peptide; HF=heart failure; NT pro-BNP=N-terminal pro B-type natriuretic peptide

pressure) or echocardiogram can help to determine cardiac abnormalities.

This can be challenging in many patients, because the symptoms, signs, and cardiac function change over time depending on loading conditions (Table 4). When uncertain, abnormal level of B-type natriuretic peptide (BNP) or N-terminal pro B-type natriuretic peptide (NT-proBNP) (especially in patients with suspected HFpEF) can improve the accuracy of the diagnosis. In a chronic setting, BNP greater than 35 pg/mL and NT-proBNP greater than 125 pg/mL are considered abnormal. In an acute setting, BNP level greater than 100 pg/mL and NT-proBNP level greater than 450 pg/mL are used to diagnose acute HF. Of note, when BNP or NT-proBNP levels are lower than their respective cut-points, the diagnosis of HF is very unlikely (high negative predictive value) (Table 5). Elevation of BNP or NT-proBNP can be due to conditions other than heart failure (Table 6).

Since many treatments for HF have shown benefit in patients with heart failure with reduced ejection fraction (HFrEF), but not in patients with higher or normal ejection fraction, LVEF should be determined at the time of HF diagnosis. This classification of HF by LVEF helps differentiate patient characteristics, treatments, and outcomes.

Patients with LVEF less than 40% are considered HFrEF, patients with LVEF greater than or equal to 50% are considered HF with preserved ejection fraction (HFpEF), and patients with LVEF between 40% and 50% are considered HF with midrange ejection fraction (HFmrEF).

Table 6. Causes of elevated natriuretic peptide

Causes of elevated NP other than HF
Cardiac causes
- Acute coronary syndrome
- Cardioversion
- Atrial fibrillation
- Cardiac surgery
Non-cardiac causes
- Advanced age
- Renal failure
- Sepsis
- Pulmonary causes: obstructive sleep apnea (OSA), severe pneumonia, pulmonary embolism, pulmonary hypertension
- Severe burn
- Anemia
- Patients receiving ARNI (elevated BNP, but not NT pro-BNP)

ARNI=angiotensin receptor-neprilysin inhibitor; BNP=B-type natriuretic peptide; HF=heart failure; NP=natriuretic peptide; NT pro-BNP=N-terminal pro B-type natriuretic peptide; OSA=obstructive sleep apnea

Classification

To guide treatment, it is useful to classify patients according to clinical parameters such as LVEF, chronicity, and symptoms (Table 7). Of note, most evidence relating to medical treatment in HF is from patients with chronic HF and low LVEF.

Classically, disease of the myocardium (cardiomyopathy) is classified by pathology into dilated, hypertrophic, and restrictive cardiomyopathy. This system of classification is still useful, but it does not cover all syndromes of HF. In addition to the mentioned criteria, patients with HF are sometimes classified by other clinical parameters that help to describe specific patient characteristics. Terminology that has been used to describe these patients includes ischemic or non-ischemic HF, high-output or low-output HF, left, right, or biventricular HF, and backward or forward HF.

Etiology and investigations

In half of the patients with HF syndrome,

Table 7. Classification of HF

Parameter	Classification	Description
ACC/AHA staging	A	At high risk for HF, but without structural heart disease
	B	Structural heart disease, but without symptoms of HF
	C	Structural heart disease with prior or current symptoms of HF
	D	Refractory HF requiring specialized interventions
NYHA functional class	I	• No limitation of physical activity
		• Ordinary physical activity does not cause symptoms of HF
	II	• Slight limitation of physical activity
		• Comfortable at rest, but ordinary physical activity results in symptoms of HF
	III	• Marked limitation of physical activity
		• Comfortable at rest, but less than ordinary activity causes symptoms of HF
	IV	• Unable to carry on any physical activity without symptoms of HF
		• Symptoms of HF at rest
LVEF	rEF	LVEF <40%
	mrEF	LVEF between 40% to 50%
	pEF	LVEF ≥50%
	Recovery	A subset of patients with HFrEF whose LVEF improves to ≥50% after treatment
Chronicity	Acute	Worsening clinical signs and symptoms, needs urgent evaluation or treatment, usually as an inpatient, can be classified into de novo HF or acute decompensated HF (ADHF)
	Chronic	Stable clinical course, may or may not have symptoms
Hemodynamic status (2 forms)	Wet	Increased degree of congestion
	Dry	Optimal intravascular volume status
	Cold	Decreased systemic perfusion, pending shock
	Warm	Adequate peripheral perfusion

ACC=American College of Cardiology; ADHF=acute decompensated heart failure; AHA=American Heart Association; HF=heart failure; HFrEF=heart failure with reduced ejection fraction; LVEF=left ventricular ejection

Table 8. Etiologies of HF

System	Selected specific etiology
Unknown	Idiopathic cardiomyopathy
Coronary artery disease	• Previous myocardial infarction - scar
	• Hibernating myocardium
	• Stunned myocardium
	• Microvascular myocardial dysfunction
	• Acute coronary syndrome
Cardiovascular abnormality	• Cardiomyopathy due to hypertension
	• Valvular heart disease
	• Familial, genetic-related cardiomyopathy (e.g., hypertrophic cardiomyopathy, dilated cardiomyopathy, left ventricular non-compaction cardiomyopathy, arrhythmogenic right ventricular cardiomyopathy)
	• Tachycardia-induced cardiomyopathy
	• Restrictive cardiomyopathy
	• Congenital heart disease
	• Pericardium (e.g., constrictive pericarditis)
Infection/inflammation	• Viral (e.g., human immunodeficiency virus, cytomegalovirus, herpes simplex virus)
	• Myocarditis
	• Parasite (e.g., Chagas disease)
Rheumatology	• Rheumatoid arthritis
	• Systemic lupus erythematosus
	• Scleroderma
Toxin	• Alcohol
	• Chemotherapy (e.g., doxorubicin, trastuzumab)
	• Methamphetamine
	• Cocaine
	• Heavy metal (e.g., copper, lead)
Endocrinology	• Abnormality in thyroid hormone
	• Abnormality in growth hormone
	• Abnormality in adrenal release hormone (e.g., pheochromocytoma or adrenal insufficiency)
	• Cardiomyopathy due to diabetes
Immunology	• Lymphocytic myocarditis
	• Giant cell myocarditis
	• Hypersensitivity and eosinophilic myocarditis
	• Endomyocardial fibrosis
Infiltrative disease	• Amyloidosis
	• Sarcoidosis
	• Hemochromatosis (iron)
	• Glycogen storage diseases (e.g., Pompe disease)
	• Lysosomal storage diseases (e.g., Fabry disease)
Others	• Stress-induced cardiomyopathy
	• Peripartum cardiomyopathy
	• Nutrition deficiency (e.g., thiamine, selenium)
	• High-output stage (e.g., anemia, arteriovenous malformation)
	• Tumor, neoplasm (primary or metastasis)
	• Muscular dystrophy

the etiology is unknown (idiopathic HF)[4]. It is important to investigate for a specific cause/etiology of HF, especially at the time of first diagnosis of HF. Some etiologies can be treated, and HF syndrome can be reversed in HF that is related to myocardial ischemia, hypertensive

Table 9. Summary of recommendations regarding the diagnosis, classification, and investigations of HF

Recommendations	COR	LOE
Patients need to have typical symptoms and signs of HF, and evidence of cardiac abnormalities to make a diagnosis of HF.	I	C
At the time of diagnosis, investigation(s) to determine LVEF is/are recommended.	I	C
At the time of diagnosis, complete history taking and physical examination to determine risk factors for and etiology of HF are recommended.	I	C
At the time of diagnosis, chronic HF patients should be classified based on LVEF and symptoms (NYHA Functional Class) to guide therapy.	I	A
Baseline investigations at diagnosis should include:	I	C
- CBC with differential cell counts		
- BUN, creatinine, electrolyte, glucose		
- HbA1c		
- ECG		
- Chest X-ray		
- Echocardiogram		
At the time of diagnosis, coronary artery disease must be appropriately screened by noninvasive or invasive investigations, depending on the patient's pretest probability of having CAD. This may include stress test (any modality) or coronary angiogram.	I	C
At the time of diagnosis, the following investigations should be considered if a specific etiology is suspected:	IIa	C
- TSH, lipid panel, liver function test		
- HIV screening		
- Ferritin, iron, total iron binding capacity		
- C-reactive protein, ESR		
- ANA and other diagnostic tests for rheumatologic diseases		
- Holter monitor		
- Sleep study		
- Cardiac MRI		
- Endomyocardial biopsy		
- Genetic counseling and testing		
- Left and right heart catheterization		
- BNP or NT-proBNP		
- Urine analysis		
- Calcium, phosphate, magnesium		

ANA=antinuclear antibodies; BUN=blood urea nitrogen; BNP=B-type natriuretic peptide; CAD=coronary artery disease; CBC=complete blood count; COR=class of recommendation; ECG=electrocardiogram; ESR=erythrocyte sedimentation rate; HbA1c=high glycated hemoglobin; HF=heart failure; HIV=human immunodeficiency virus; LVEF=left ventricular ejection fraction; LOE=level of evidence; MRI=magnetic resonance imaging; NT-proBNP=N-terminal pro B-type natriuretic peptide; NYHA=New York Heart Association; TSH=thyroid stimulating hormone

heart disease, alcohol-induced cardiomyopathy, tachycardia-induced cardiomyopathy, and valvular heart disease.

Patient prognosis also depends on the patient's initial cardiac pathology. Since myocardial ischemia is a common and treatable cause of HF, physicians should suspect and appropriately investigate for coronary artery disease. Etiologies of HF and investigations in patients with newly diagnosed HF are shown in Table 8 and 9, respectively.

Of note, the etiology of HF is not the same as the precipitating factors or triggers of worsening HF. Many conditions can be both the etiology of and a precipitating factor for HF.

The term cardiomyopathy is often used interchangeably with the term HF; however, this is not always correct. As mentioned above, HF is a clinical syndrome that is associated with typical symptoms and signs of an abnormal cardiovascular system. The term cardiomyopathy is usually reserved for myocardial diseases, which are caused by abnormal myocytes. Cardiomyopathy could be primary, such as dilated cardiomyopathy, or secondary, such as tachycardia-induced cardiomyopathy.

Conflicts of interest

The authors declare no conflict of interest.

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